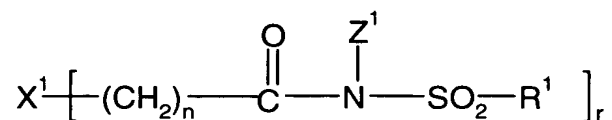




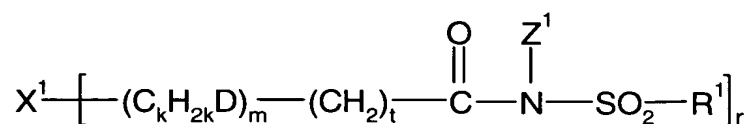
2. The compound of claim 1, wherein the compound has a formula



wherein

- 5 n is an integer of 1 to 100; and  
said compound is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

3. The compound of claim 1, wherein the compound has a formula

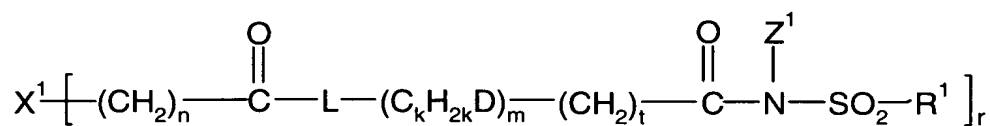


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wherein

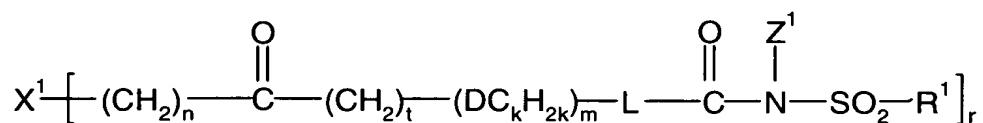
- D is oxygen, sulfur, or NH;  
t is an integer of 0 to 12;  
k is an integer of 2 to 4;  
15 m is an integer of 1 to 200; and  
said compound is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

4. The compound of claim 1, wherein the compound has a formula



20

or



wherein

D is oxygen, sulfur, or NH;

n is an integer of 1 to 100;

m is an integer of 1 to 200;

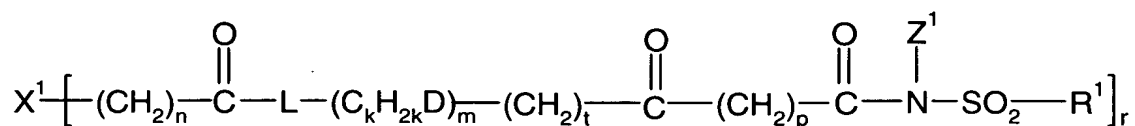
t is an integer of 0 to 12;

k is an integer of 2 to 4;

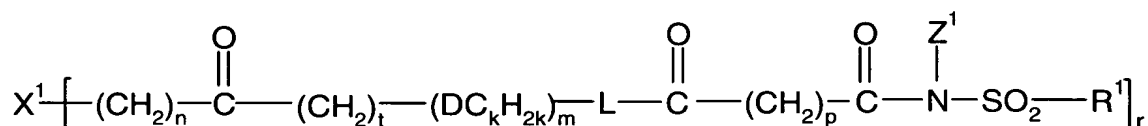
L is oxygen or NR<sup>d</sup> where R<sup>d</sup> is hydrogen or alkyl; and

said compound is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

5. The compound of claim 1, wherein the compound is of formula



or



wherein

D is oxygen, sulfur, or NH;

n is an integer of 1 to 100;

m is an integer of 1 to 200;

t is an integer of 0 to 12;

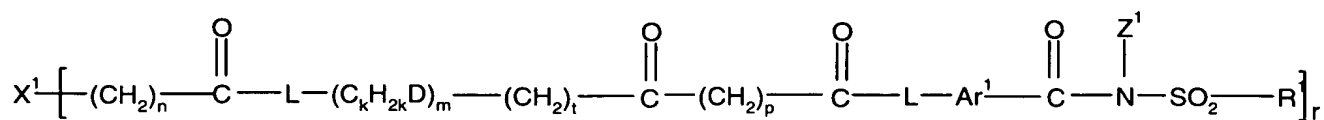
k is an integer of 2 to 4;

p is an integer of 1 to 10;

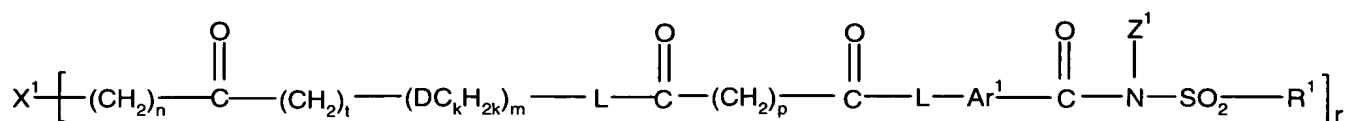
L is oxygen or NR<sup>d</sup> where R<sup>d</sup> is hydrogen or alkyl; and

said compound is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

6. The compound of claim 1, wherein the compound is of formula



or



wherein

D is oxygen, sulfur, or NH;

n is an integer of 1 to 100;

m is an integer of 1 to 200;

t is an integer of 0 to 12;

k is an integer of 2 to 4;

p is an integer of 1 to 10;

L is oxygen or  $NR^d$  where  $R^d$  is hydrogen or alkyl;

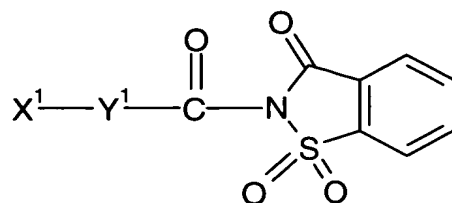
$Ar^1$  is an arylene; and

said compound is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

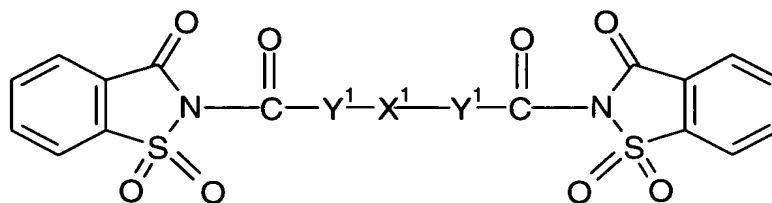
7. The compound of claim 1, wherein  $Z^1$  is a  $C_{1-10}$  alkyl and  $R^1$  is a  $C_{1-10}$  fluoroalkyl.

8. The compound of claim 1, wherein  $Z^1$  is an aryl and  $R^1$  is a  $C_{1-10}$  fluoroalkyl.

9. The compound of claim 1, where the compound is of formula

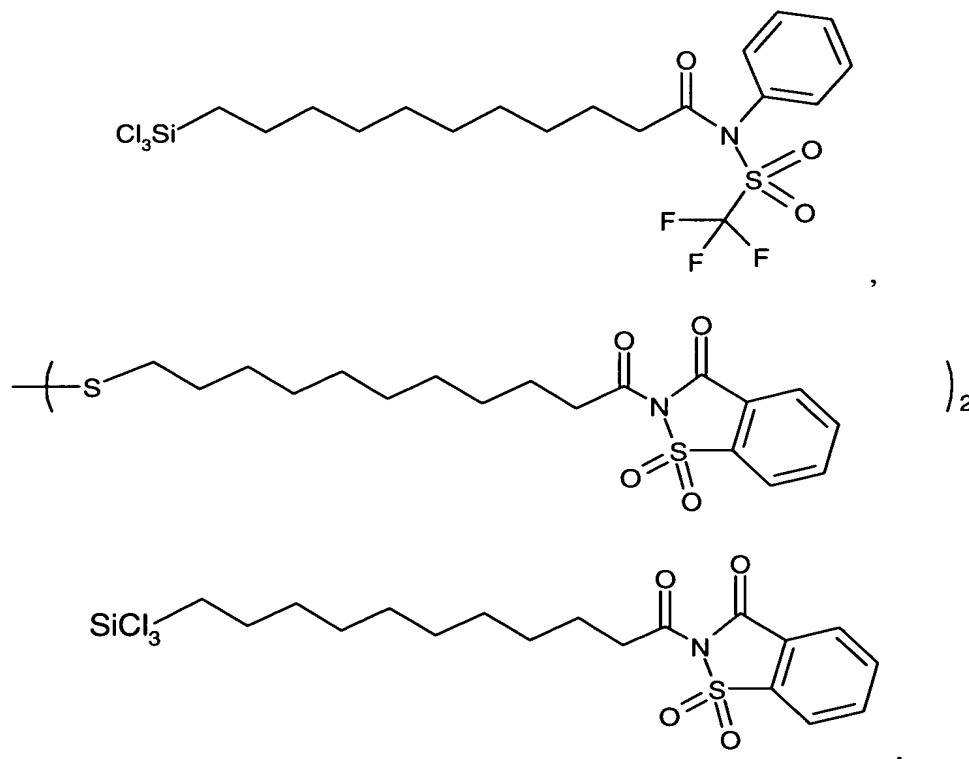


where  $X^1$  is monovalent or

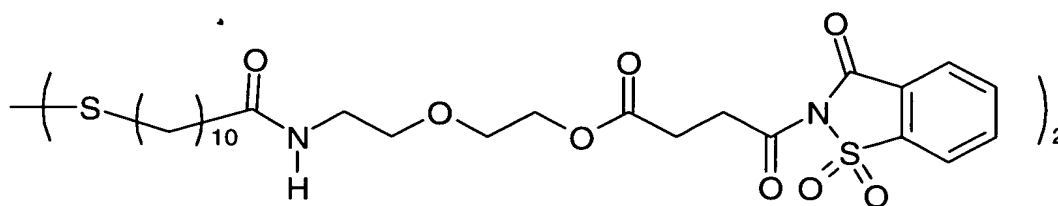
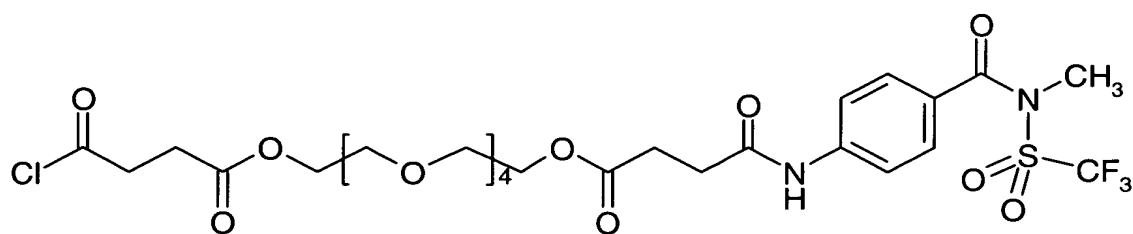
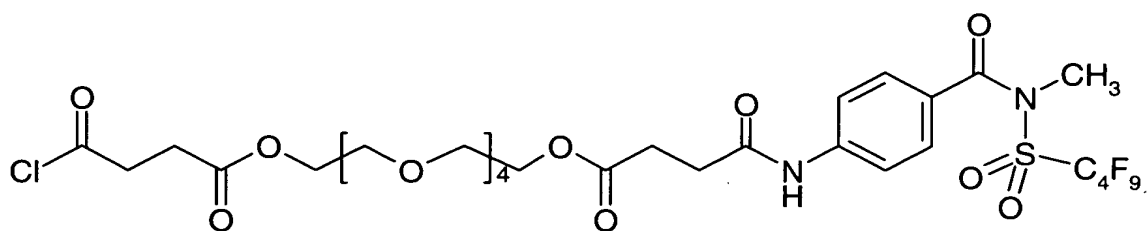
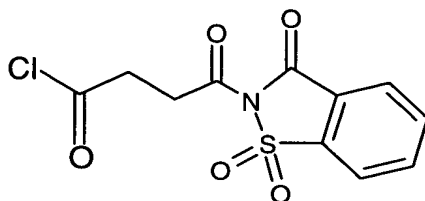
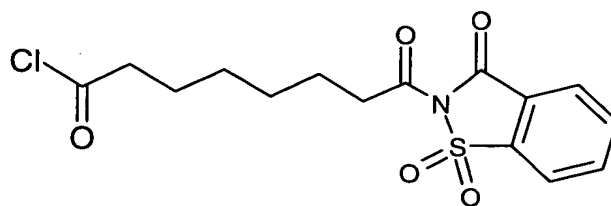
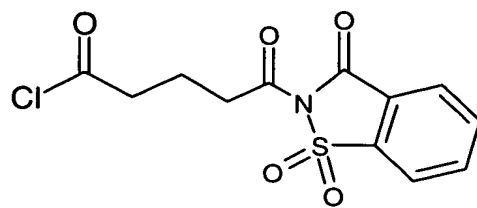


- 5 where  $X^1$  is divalent and said compound is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

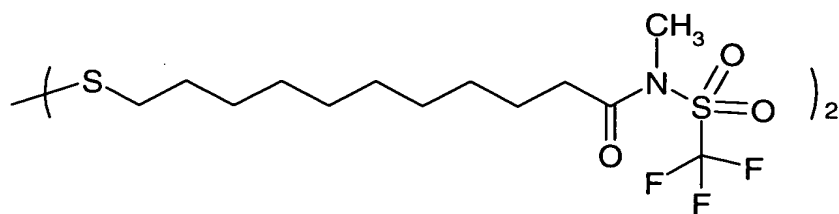
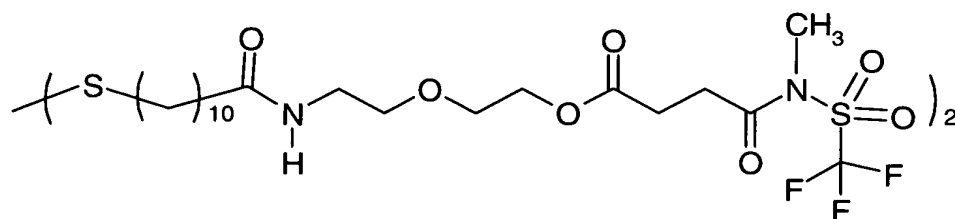
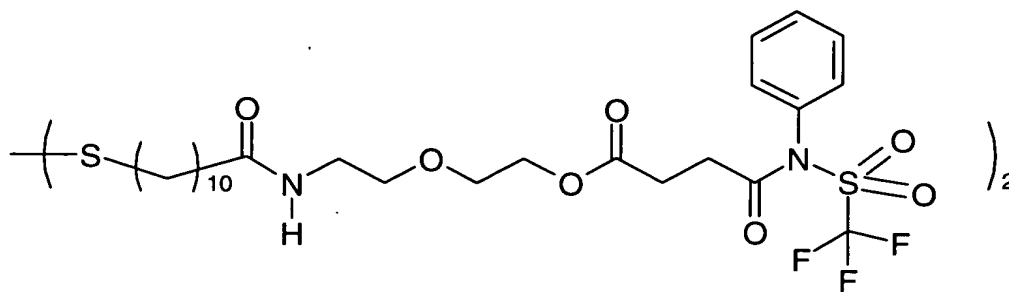
10. The compound of claim 1, wherein the compound is



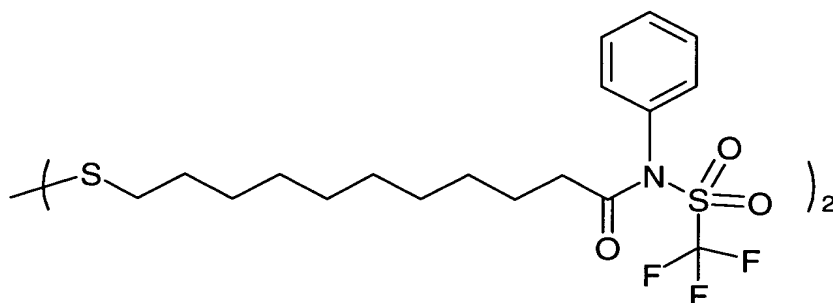
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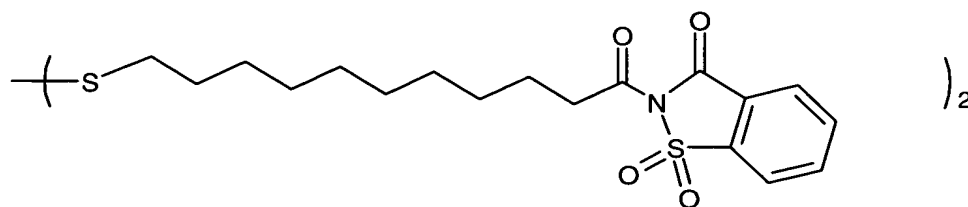


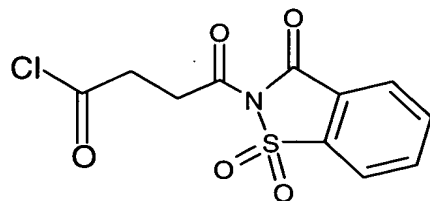
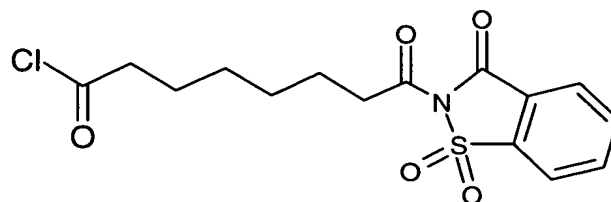
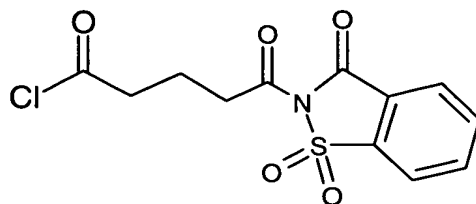
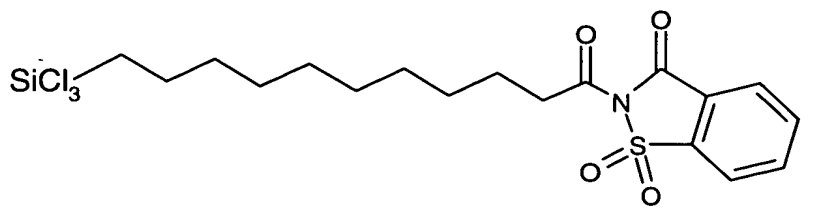
, or



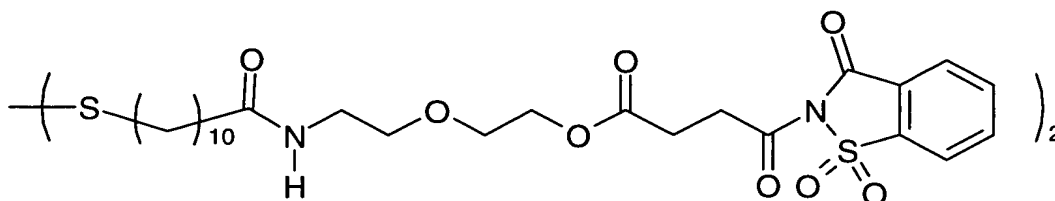
5 said compound being unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

11. The compound of claim 1, wherein the compound is





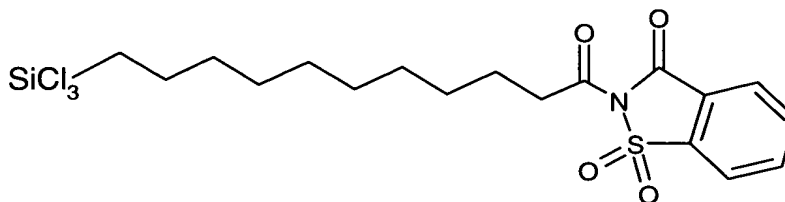
, or



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said compound being unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

12. The compound of claim 1, wherein the compound is



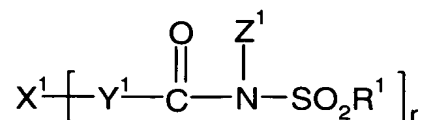
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13. An article comprising:

a substrate;

a substrate-attached tethering group comprising a reaction product of a complementary functional group G on a surface of the substrate with a compound of  
5 Formula I



I

wherein

$X^1$  is a substrate-reactive functional group selected from a carboxy,  
10 halocarbonyl, halocarbonyloxy, cyano, hydroxy, mercapto, isocyanato, halosilyl, alkoxysilyl, acyloxysilyl, azido, aziridinyl, haloalkyl, tertiary amino, primary aromatic amino, secondary aromatic amino, disulfide, alkyl disulfide, benzotriazolyl, phosphono, phosphoroamido, phosphato, or ethylenically unsaturated group;

$Y^1$  is a single bond or a divalent group selected from an alkylene,  
15 heteroalkylene, arylene, carbonyl, carbonyloxy, carbonylimino, oxy, thio,  $-NR^d$  - where  $R^d$  is hydrogen or alkyl, or combinations thereof;

$Z^1$  is an alkyl, aryl, or  $-(CO)R^a$  wherein  $R^a$  together with  $R^1$  and groups to which they are attached form a four to eight membered heterocyclic or heterobicyclic group having a nitrogen heteroatom and a sulfur heteroatom, wherein said heterocyclic or  
20 heterobicyclic group can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

$R^1$  is an alkyl, fluoroalkyl, chloroalkyl, aryl,  $NR^b R^c$  wherein  $R^b$  and  $R^c$  are each an alkyl group or taken together with the nitrogen atom to which they are attached form a four to eight membered cyclic group, or  $R^1$  together with  $R^a$  and the groups to  
25 which they are attached form the four to eight membered heterocyclic or heterobicyclic group that can be fused to the optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

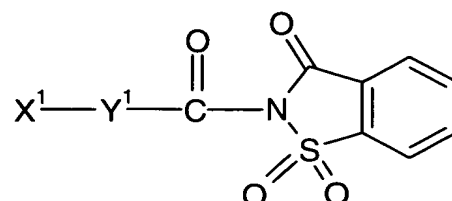
$r$  is equal to 1 when  $X^1$  is a monovalent group or equal to 2 when  $X^1$  is a divalent group;

G is the complementary functional group capable of reacting with  $X^1$  to form an ionic bond, covalent bond, or combinations thereof; and

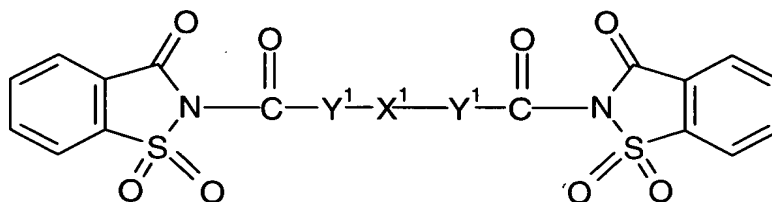
said tethering group is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof.

5

14. The article of claim 13, wherein the compound is of formula



where  $X^1$  is monovalent or



10

where  $X^1$  is divalent.

15. The article of claim 13, wherein the group G is selected from hydroxy, mercapto, primary aromatic amino group, secondary aromatic amino group, secondary aliphatic amino group, azide, carboxyl, carboxylic acid anhydride, isocyanate, halocarbonyl, halocarbonyloxy, acrylate, silanol, or nitrile.

15

16. The article of claim 13, wherein  $Z^1$  is an aryl or an alkyl and  $R^1$  is a fluoroalkyl.

20

17. The article of claim 13, wherein the substrate comprises a polymeric material.

18. The article of claim 13, wherein the substrate comprises a polyimide or polyester film.

25

19. The article of claim 13, wherein the substrate is multilayered and has an outer layer comprising gold.

20. The article of claim 13, wherein the substrate is multilayered and has an outer layer comprising diamond-like glass.

21. The article of claim 13, wherein the substrate is a multilayer substrate comprising;

a support layer comprising polyimide or polyester;

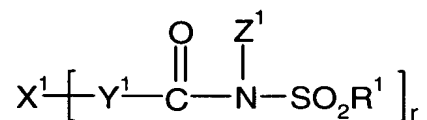
an outer layer comprising diamond-like glass;

and a layer of diamond-like glass positioned between the support layer and the outer layer.

22. The article of claim 13, wherein the substrate is in the form of a bead.

23. A method of immobilizing an amine-containing material to a substrate, said method comprising:

selecting a compound of Formula I



# I

wherein

X<sup>1</sup> is a substrate-reactive functional group selected from a carboxy, halocarbonyl, halocarbonyloxy, cyano, hydroxy, mercapto, isocyanato, halosilyl, alkoxysilyl, acyloxysilyl, azido, aziridinyl, haloalkyl, tertiary amino, primary aromatic amino, secondary aromatic amino, disulfide, alkyl disulfide, benzotriazolyl, phosphono, phosphoroamido, or phosphato;

Y<sup>1</sup> is a single bond or a divalent group selected from an alkylene, heteroalkylene, arylene, carbonyl, carbonyloxy, carbonylimino, oxy, thio, -NR<sup>d</sup>- where R<sup>d</sup> is hydrogen or alkyl, or combinations thereof;

$Z^1$  is an alkyl, aryl, or  $-(CO)R^a$  wherein  $R^a$  together with  $R^1$  with groups to which they are attached form a four to eight membered heterocyclic or heterobicyclic group having a nitrogen heteroatom and a sulfur heteroatom, wherein said heterocyclic or heterobicyclic group can be fused to an optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group;

$R^1$  is an alkyl, fluoroalkyl, chloroalkyl, aryl,  $NR^bR^c$  wherein  $R^b$  and  $R^c$  are each an alkyl group or taken together with the groups to which they are attached form a four to eight membered cyclic group, or  $R^1$  together with  $R^a$  and the groups to which they are attached form the four to eight membered heterocyclic or heterobicyclic group that can be fused to the optional aromatic group, optional saturated or unsaturated cyclic group, or optional saturated or unsaturated bicyclic group; and

$r$  is equal to 1 when  $X^1$  is a monovalent group or equal to 2 when  $X^1$  is a divalent group; and

said is unsubstituted or substituted with a halo, alkyl, alkoxy, or combinations thereof;

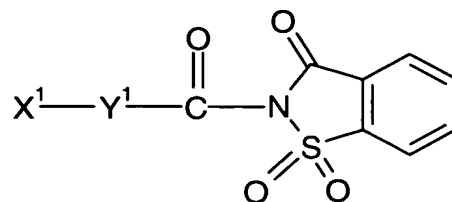
providing a substrate having a complementary functional group capable of reacting with  $X^1$ ;

preparing a substrate-attached tethering group by reacting  $X^1$  with the complementary functional group on the substrate resulting in an ionic bond, covalent bond, or combination thereof; and

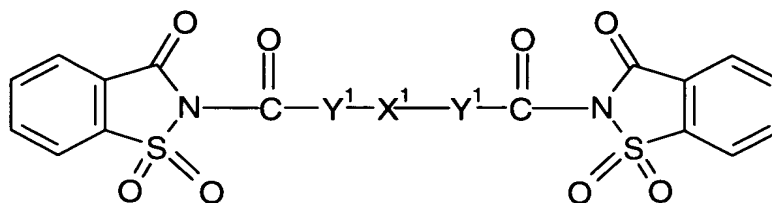
reacting an amine-containing material with a N-sulfonylaminocarbonyl group of the substrate-attached tethering group to form a carbonylimino-containing connector group between the substrate and the amine-containing material.

24. The method of claim 23, wherein the amine-containing material is an amine-containing analyte, an amino acid, peptide, DNA, RNA, protein, enzyme, organelle, immunoglobulin, or fragment thereof.

25. The method of claim 23, wherein the compound is of formula



where  $X^1$  is monovalent or



5 where  $X^1$  is divalent.

26. The method of claim 23, wherein  $Z^1$  is an aryl or an alkyl and  $R^1$  is a fluoroalkyl.

10 27. An article comprising a multilayer substrate comprising:  
a polymeric layer;  
a diamond-like glass layer; and  
a diamond-like carbon layer positioned between the polymeric layer and the  
diamond-like glass layer.

15

28. The article of claim 27 further comprising a tethering group attached to a surface of the diamond-like glass layer, said tethering group comprising a N-sulfonylamino carbonyl group.

20 29. The article of claim 27, further comprising an immobilized amine-containing material attached to the substrate through a divalent connector group.

25 30. The article of claim 29, wherein the amine-containing material is an amine-containing analyte, amino acid containing analyte, an amino acid, peptide, DNA, RNA, protein, enzyme, organelle, immunoglobulin, or fragment thereof.

31. The article of claim 29, wherein the amine-containing material is an antibody and the antibody is further bound to an antigen.

5 32. The article of claim 29, wherein the amine-containing material is an antigen and the antigen is further bound to an antibody.

33. The article of claim 29, wherein the amine-containing material is an immunoglobulin.

10

34. The article of claim 29, wherein the amine-containing material is further bound to a bacterium.

35. The article of 34, wherein the bacterium is *Staphylococcus aureus*.

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